

DIACRITICAL MARKS FOR ROMAN transliteration OF
DEVANAGARI SCRIPT

1. Short Vowels

अ - A, a इ - I, i उ - U, u ऋ - R, r लृ - l

2. Long Vowels

आ - Ā, ā ई - Ī, ī ऊ - Ū, ū ए - E, e ओ - O, o

ऐ - Ai, ai औ - Au, au

3. Anusvāra: and Visarga: - अं - [ँ] : - Ḥ, ḥ

4. Non-aspirant - ऽ

5. Consonents

क् - K, k	ख् - Kh, kh	ग् - G, g	घ् - Gh, gh	ङ् - ṅ, ṅ
च् - C, c	छ् - Ch, ch	ज् - J, j	झ् - Jh, jh	ञ् - Ṇ, ṅ
ट् - Ṭ, ṭ	ठ् - Ṭh, ṭh	ड् - Ḍ, ḍ	ढ् - Ḍh, ḍh	ण् - Ṇ, ṅ
त् - T, t	थ् - Th, th	द् - Ḍ, ḍ	ध् - Dh, dh	न् - N, n
प् - P, p	फ् - Ph, ph	ब् - B, b	भ् - Bh, bh	म् - M, m
य् - Y, y	र् - R, r	ल् - L, l	व् - V, v	
श् - Ś, ś	ष् - Ṣ, ṣ	स् - S, s	ह् - H, h	

6. Compound letters - क्ष् - Kṣ, kṣ ज्ञ् - Jñ, jñ त्र् - Tr, tr

THE VEDA AND THE CONCEPT OF 360 DEGREES OF ANGLES OF A CIRCLE

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INTRODUCTION

It is well known that each circle has 360° of angles. But why 360°? Why not 400° or 500° to make calculations easier? What is the basic concept behind this computation of 360° of angles for a circle? Who first, when and in what text, developed this concept? When we analyse and go in-depth into these details, we will astonish to know the mighty knowledge and the wisdom of the Rishies of our Motherland, Bharat.

THE VEDA

We all know well, the Veda are the oldest scriptures in the whole world. In Hinduism, Veda are worshipped as Anadi and Sanatana. That means Veda are eternal. Veda, as we know, are full of knowledge and wisdom. Veda, the Sanskrit word derived from the root, 'Vid' which means, 'to know, to learn'. Hence, a thorough study of Veda will not only guide us spiritually, but give us the most modern scientific knowledge also.

RG VEDA

Rg Veda Samhitā 1st Maṇḍalam 164th Sūktam (Hymn) 48th Mantram (verse) reveals¹

द्वादश प्रधयश्चक्रमेकं त्रीणि नभ्योन क उ तच्चिकेत ।

तस्मिन्त्साकं त्रिशता न शङ्कवोऽर्पिताः षष्टिर्न चलाचलासः ॥

Dvādaśa pradhayaś cakramekam trīni nabhyāni ka u tacciketa |

Tasmitsākam triśatā na Śaṅkavo'rpitāḥ ṣaṣṭirna calācalāsaḥ ||

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Meaning : Dvadasa – 12; Pradhaya – the arcs of a wheel; cakram ekam – one wheel; trini–three; nabhyani – axles or hubs or centre part of the wheel; Trisata shashtirna – 360; Sankava – spokes of the wheel; Calacalasaḥ – movable and immovable. The arcs are twelve, the wheel is one and three are the axles. Who indeed knows it? Within it are collected three hundred and sixty spokes, which are as it were movable and immovable.²

**ṚG VEDIC DESCRIPTION OF ECLIPTIC AS ONE WHEEL
WITH 12 ARCS & 360 SPOKES**

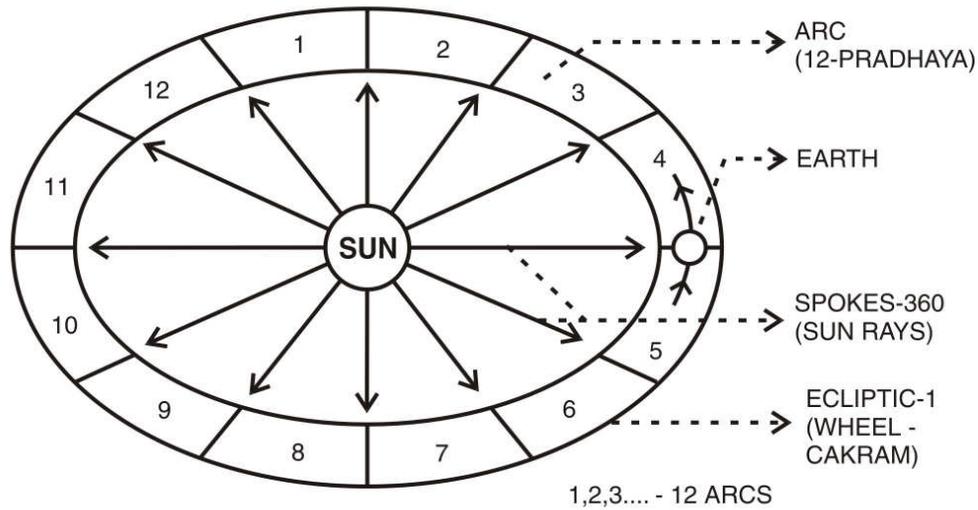


FIGURE - 1

Further, Ṛg Veda Samhitā 1st Maṇḍalam 164th Sūktam (Hymn) 11th Mantram (verse) reveals,³

द्वादशारं नहि तज्जराय वर्वति चक्रं परि द्यामृतस्य ।

आ पुत्रा अग्ने मिथुनासो अत्र सप्त शतानि विंशतिश्च तस्थुः ॥

Dvādaśāram nahi tajjarāya varvarti cakram pari dyāmṛtasya |

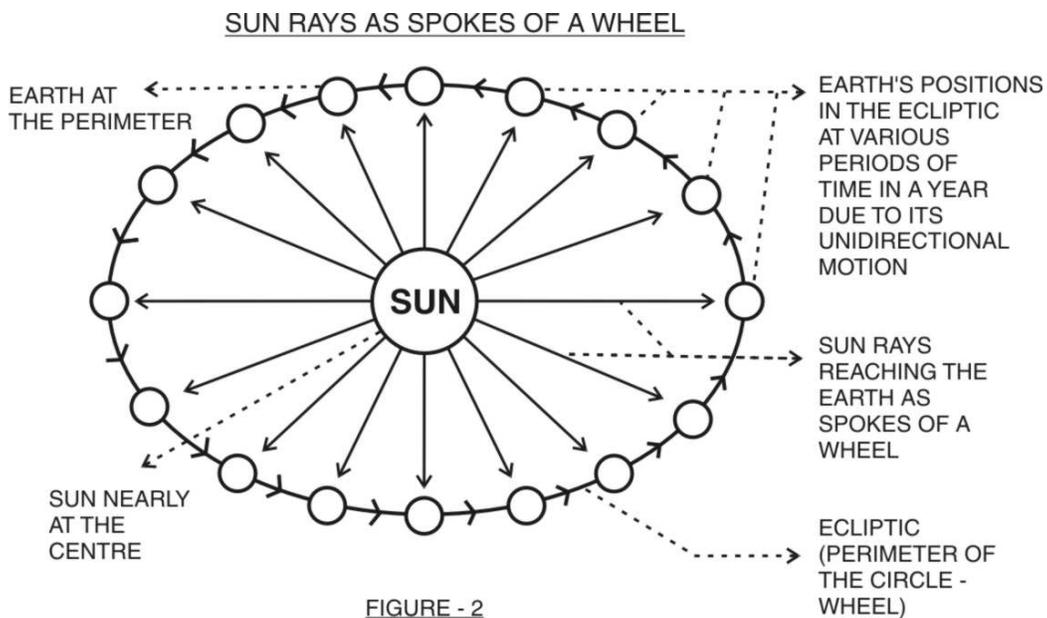
Ā putrā agne mithunāso atra sapta śatāni vimśatiśca tasthuḥ ||

Meaning : Dvadasa – 12 ; Mithunaso putra – sons in pairs; Sapta satani vinsati – 720;

The wheel of law (Sun) with 12 arcs goes round and round the Heaven. It is not indeed to be decayed. Here stand, O Agni, the seven hundred and twenty sons in pairs.

The astronomical events happening in the celestial sphere are expressed beautifully and poetically in these verses of Ṛg Veda Samhita. The celestial pathway in which the Earth revolves

round the Sun, with respect to the fixed stars of the sky, is called the Ecliptic. The ecliptic, though frequently drawn as circular, is an elliptical pathway (0.0167/ 1 of Ellipse), encircling the Sun. The above-mentioned verse of R̥g Veda views this same ecliptic as a wheel having 12 arcs, 3 axles and 360 spokes and mentions it as cakram ekam - one wheel. We all know that the Earth revolves round the Sun, in a unidirectional motion, in the ecliptic. This means that the Earth's position in the ecliptic will vary with the time. For example, at each Sunrise within a year, the Earth will definitely be at different positions in the ecliptic with respect to the fixed stars. If the light rays of the rising Sun, reaching the Earth in the morning, are imagined as spokes of a wheel, then there will be as many number of spokes, as the total number of Earth's positions at Sunrise, in the ecliptic which in turn, is equal to the total number of Sunrises in a year.



The verse 1-164-48 of R̥g Veda mentions that there are 360 spokes for this one wheel – the ecliptic. So in turn, it means that there are 360 Sunrises in a year. Sūrya siddhāntaḥ reveals “Udayād Udayam bhānor bhūmi Sāvanavāsarāḥ”⁴ It means that Savana dina (one day) is the interval of time between one Sunrise and the next consecutive Sunrise.⁵ So if there are 360 Sunrises in a year, then it means that there are 360 days for a year. Thus, R̥g Veda expresses that there are 360 spokes for one wheel, which in turn means 360 days for one year. The 12 arcs are the 12 divisions of

the perimeter of this wheel (ecliptic), which denote the 12 months of a year. The 3 axles denote the three double seasons of one year.

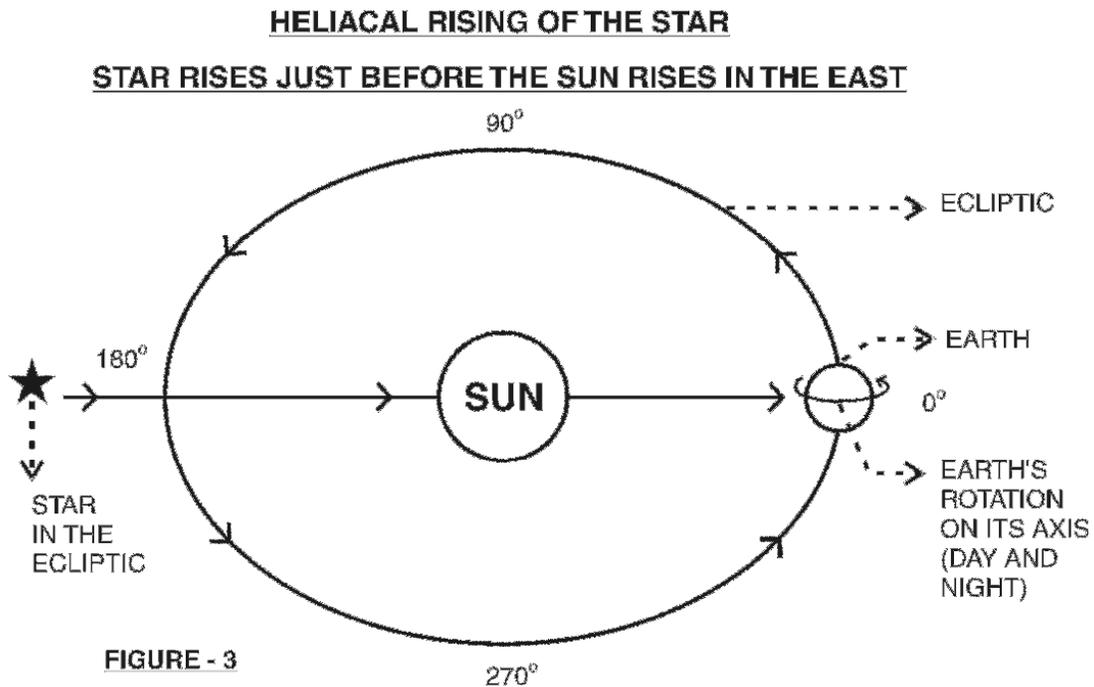
So in the fore mentioned verses of R̥g Veda,

1. One wheel denotes the ecliptic – the elliptical celestial pathway of the Earth, encircling the Sun.
2. Twelve arcs denote 12 divisions of the perimeter of the wheel and 12 months of a year.
3. 360 spokes denote 360 days of one Sāvana year.
4. 720 children in pairs mentioned in the verse 1-164-11 of R̥g Veda denote 360 day time and 360 night time in pairs making a total of 720, that is 360 days of one Sāvana year.

Taittiriya Samhitā of Kṛṣṇa Yajur Veda (7-5-1) also gives the same view and mentions 360 stotriya (verses) for recitation for 360 nights of a year (samvatsara).⁶ The calculation of 360 days for one savana year has its base in the Yuga calculations and is calculated by observing the heliacal rising of the stars of the ecliptic.

HELICAL RISING OF THE STARS

The rising of any star in the ecliptic in the eastern horizon, early in the morning, just before the Sunrise is called Heliacal rising of that particular star.



This heliacal rising of any particular star of the ecliptic, will happen only once in the whole year. The particular day of the heliacal rising of the star has been given a special importance in Vedic rituals. Taittiriya Brāhmaṇa (1-5-2-1) mentions⁷ about the heliacal rising of the stars and this particular verse is repeated even to-day as ‘Punyāha Vacana’ the purification ceremony, preceding the commencement of all important religious ceremonies. A star, which rises heliacally to-day, will rise in the eastern sky, at about four minutes earlier the next day. This is due to the revolution of the Earth round the Sun in the ecliptic, at the velocity of about 1° per day and to cover this extra 1° revolution of each day, the Earth has to rotate extra 1° in its own axis every day, which requires extra four minutes of time. 360° rotation of the Earth requires about 24 hours i.e. 24×60 (1440) minutes, hence for 1° four minutes ($1440 \div 360$). The period of one revolution of the Earth round the Sun is one year and the rotation of the Earth on its own axis the cause for day and night. Thus, in one month – 30 days – it rises (30×4) 120 minutes - 2 hours earlier. In the same way in 6 months, this self same star will rise in the east in the evening in our latitude, immediately after the Sun sets in the west, that is 12 hours earlier the Sunrise of the next day. This is called Acronycal rising of the star.⁸

ACRONYCAL RISING OF THE SAME STAR (6 MONTHS AFTER)
STAR RISES JUST AFTER THE SUN SETS IN THE WEST

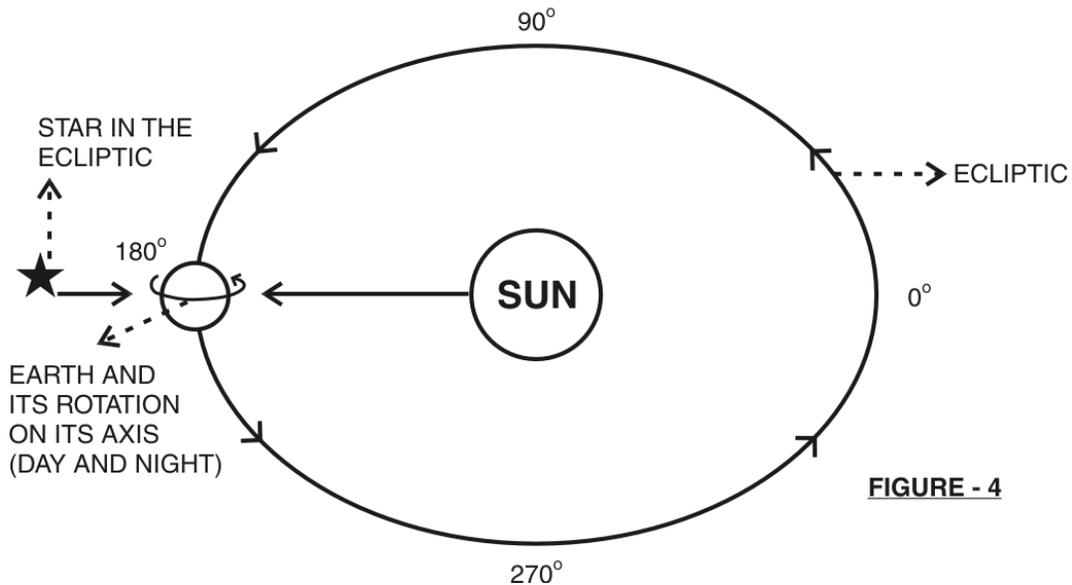


FIGURE - 4

In this manner, after another 6 months, that is, one full year after its heliacal rising, the self same star again rises heliacally in the east, just before the Sun rises. Our ancestors counted the total number of

Sunrises between the two consecutive heliacal risings of the self same star of the ecliptic, that is during Earth's one full revolution round the Sun, that is in one full year. It was found, that there are ordinarily 365 Sunrises during this period. Out of these 365 Sunrises, based on Yuga calculations, only 360 are taken as the days of one savana year.

YUGA CALCULATIONS

Āryabhaṭṭīya of Āryabhaṭṭa (kālakriya pāda - verse 7) says,⁹

रविवर्षं मानुष्यं तदपि त्रिंशद्गुणं भवति पित्रयम् ।

पित्रयं द्वादशगुणितं दिव्यं वर्षं विनिर्दिष्टम् ॥

Ravivarṣam mānuṣyam tadapi trimśad guṇam bhavati pitrayam |

Pitrayam dvādaśa guṇitam divyam varṣam vinirdiṣṭam ||

A Solar year is a year of men. Thirty times of this, is a year of Pitṛ. Twelve times a year of Pitṛ is a Divine year or a year of Gods. That is 360 years of men and one year of Gods are equal.

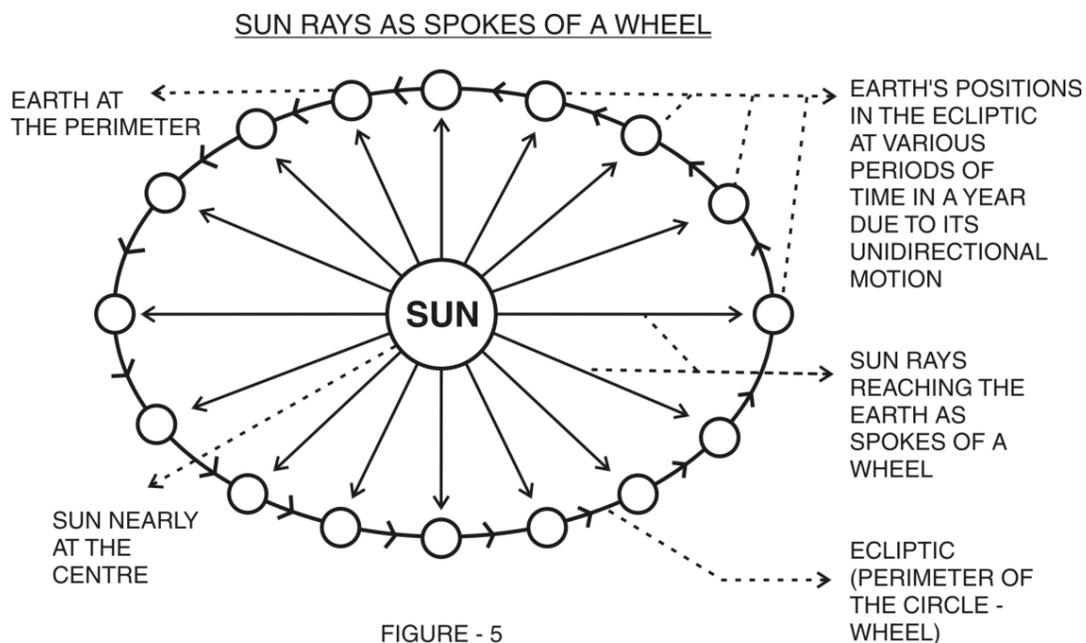
Śiṣyadhīvrddhida Tantram of Lallācārya in its 3rd and 7th verses of Prathamodhyāyaḥ of Madhyagrahādhikāraḥ, says that 432 multiplied by 10,000 gives the number of years in a yuga (43,20,000 years). 1,55,520 multiplied by 10,000 gives the number of solar days in a Yuga (155,52,00,000). Hence in one year there are 360 days (155,52,00,000 / 43,20,000 = 360).¹⁰ Sūrya Siddāntaḥ reveals “Divyābda’ as one year of Gods of Heaven which is equal to 360 of our solar years.¹¹ Our one year is equal to one day of Gods¹¹. God’s one year thus contains 360 days. Thus the civil or Sāvana year consists of 360 days and 12 months of 30 days each.^{12, 13} The number 360 is common in terms of days of one year for Brahma, Gods and men according to Yuga Calculations. But the actual duration in each case varies, and is not equal. Further, in the case of men, the year computed with A. 360 days is Civil (Sāvana) year, B. 365.242190 days is Tropical year (Sāyana Sauravarṣa) C. 365.256364 days is Sidereal year (Nirāyana Sauravarṣa) and D. 354.36706 days is Synodic Lunar Year. Besides, Particle Physics reveals there exists Symmetry Breaking Phenomenon. Thus, there is no absolute 100% symmetry; instead a very slight asymmetry usually exists in Nature. Hence the duration of the Earth’s revolution round the Sun is not exactly 360 days, but of 365.242190 days.

Besides, out of the 365 Sunrises between the two consecutive heliacal risings of the self same

star, only 360 are computed as the number of days of one Sāvana year. The remaining five days are meant for conducting Panca Rātra Yajna to complete the seasons. As there are 365 Sunrises in one year, if we calculate only 360 days for one year, the seasonal periods tend to vary in the coming years. In order to ensure that the seasonal periods to fall in the same months of all the forthcoming years, our ancestors conducted this yajna, for five nights at the end of every savana year. After completing this Yajna for 5 days, the 6th day is calculated as the 1st day of the next savana year. Kṛṣṇa Yajurveda Taittirīya Samhitā 7-1-10 reveals¹³ that 5 days are required over and above the savana year of 360 days to complete the seasons, adding specifically that 4 days are too short and 6 days are too long.

360 DEGREES OF ANGLES OF A CIRCLE

The Earth revolves round the Sun, in a unidirectional motion. Every day, it moves forward a little, from its previous day's position at the perimeter of this wheel (the ecliptic). Thus, the Earth will be at 360 different places at Sunrise, with respect to the fixed stars, in one savana year of 360 days. The rays of the rising Sun, reaching the Earth in the morning, resembles and can be expressed as the spokes of a wheel, with the Sun nearly at its centre and the Earth at the perimeter. So, there will be 360 spokes of rays of the rising Sun reaching the Earth, in the mornings of one savana year of 360 days.



Thus there will be 360 spokes, from the Sun which is nearly at the centre, to the Earth at the perimeter of the wheel (ecliptic), during Earth's one full revolution round the Sun (in one full circle). Then each spoke is calculated as one unit of angle of measurements for this circle – the ecliptic. Since there are 360 spokes for this one wheel, there will be 360 units of angles of measurements for one full circle. This is what exactly, the Rg Veda verse 1-164-48 had already revealed. In our Nation, 'Amsa' is the unit for the angle of measurements of a circle, whose modern equivalent is degree. Thus, the concept of 360 degrees (Amsa) of angles for a circle had its origin in Rg Veda itself.

TIME MEASUREMENTS

Not only this, but the other time measurements in our Nation, is completely scientific and is based on the angular distance covered by the Earth on revolving round the Sun in the ecliptic, in that particular time.

Āryabhaṭṭiya of Āryabhaṭṭa (kālakriya pāda - verse 1 & 2) mentions¹⁵

वर्षं द्वादश मासास्त्रिंशद् दिवसो भवेत् स मासस्तु ।

षष्टिर्नाड्यो दिवसः षष्टिश्च विनाडिका नाडी ॥

Varṣam dvādaśā māsāstrimśad divaso bhavet sa māsastu |

Ṣaṣṭir nāḍyo divasaḥ ṣaṣṭiśca vināḍikā nāḍī ||

गुर्वक्षराणि षष्टिर्विनाडिकाक्षी षडेव वा प्राणाः ।

एवं कालविभागः क्षेत्रविभागस्तथा भगनात् ॥

Gurvakṣrāṇi ṣaṣṭir vināḍikārksī ṣaḍeva vā prāṇāḥ |

Evam Kālavibhāgaḥ Kṣetravibhāgastathā bhaganāt ||

Meaning:- A year consists of 12 months. A month consists of 30 days. A day consists of 60 nadies. A nadi consists of 60 vinadikas. A vinadika is equal to (the time taken by a man in normal conditions in pronouncing) 60 long syllables (with moderate flow of voice) or (in taking) six respirations. This is

the division of time. The division of a circle (the ecliptic) proceeds in a similar manner from the revolution.

Vaṭeśvara Siddhānta and Gola by Vaṭeśvara mentions¹⁶ in the 8th śloka of Bhagananirdeśaḥ of Madhyagatyadhikāraḥ (1st Adhyāyaḥ of 1st Adhikāraḥ) as “Six Asus make one sidereal pala, sixty pala make a ghaṭika. Sixty ghaṭika make a day. 30 days make a month, and 12 times of that, is a year. The divisions of the circle too have been defined in the same manner as those of time, excepting those up to asu”.

The Time Measurements

1 Sāvana year - 12 months – 360 days

1 Month - 30 Days

1 Day - 60 Nāḍi (Nāḍika,
ghaṭika)

1 Nāḍi - 60 Vināḍika (Vighaṭika)

1 Vināḍika - 60 Gurvakshara
(Long syllables)

The Divisions of a Circle

1 Revolution - 12 rasis (Pradhaya, sign)–
(Circle, Bhagana) 360 Amsa (Degrees)

1 Rasi - 30 Amsa (Degrees)

1 Amsa - 60 Lipta (Kala-minutes)

1 Lipta - 60 Vilipta (Vikala-
Seconds)

1 Vilipta - 60 Tatpara (Thirds)

Thus the time division in our Nation is based on the angular distance covered by the Earth, in the ecliptic, round the Sun, in that particular time. For example, one year is the time required for the Earth to complete 360° (one full circle), one month for 30° (one arc-rasi-sign), one day for 1° (amsa-spoke), 1 nāḍika for 1' (lipta-kala), 1 vināḍika for 1" (vilipta-vikala) and 1 gurvakshara for 1''' (third-tatpara) of angular distance, in its revolution round the Sun in the ecliptic.

Circle Measurements	1 circle (360 degrees – Amsa)	1 Degree (60 minutes – Lipta)	1 Minute (60 seconds - Vilipta)	1Second (60 thirds- Tatpara)	1 Third- (1 Tatpara)
Time Measurements	1 Savana year (360 days)	1day(60 ghatika)	1 Ghatika (60 vinadika)	1 Vinadika (60 Gurvakshara)	1Gurvakshara

Astonishingly, Āryabhaṭṭyam reveals in the above mentioned śloka 1 & 2 of 3rd Adhyaya, that the respiratory rate of men is 15 per minute (6 respirations per Vināḍika and $2\frac{1}{2}$ Vināḍika is equal to 1 minute, so, $2\frac{1}{2} \times 6 = 15$) & **correlated it with the Natural event i.e. the revolution of the Earth round the Sun in the Ecliptic.** The modern Medical Text Books confirms this fact. For example, 1. Review of Medical Physiology – A text book of Human Physiology studied in Medical Colleges worldwide and authored by William F. Ganong, University of California mentions the normal respiratory rate of human beings as 12 -15 per minute, 2. Hutchison's Medical Text Book mentions it as 14 -18 per minute and 3. Text Book of Human Physiology by Sarada Subramaniam gives this value as 14-20 per minute. Hence, the value of Āryabhaṭṭa is not only correct scientifically but also it correlates with the natural event of the Earth's revolution round the Sun, which is still a future concept and approach in modern science.

CONCLUSION

From the above table, we can able to conclude that there is an exact confluence of the spatial distance in the ecliptic travelled by the Earth in its unidirectional motion and the time measurements developed in our Nation. This is completely scientific, totally based on the angular distance covered by the Earth in the ecliptic and the time required for that.

Thus, the time space and the direction concept (Dik Deśa Kāla Vardhamāna) of the most modern science and the concept of 360° of angles of a circle had been developed scientifically and applied in the day-to-day life, by our ancestors, in the remotest antiquity itself and this concept is fully revealed by Veda which are Anādi and Sanātana.

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